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Boron Isotope Intercomparison Project (BIIP): Development of a new carbonate standard for stable isotopic analyses

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Boron consists of only of two isotopes with a relatively large mass difference ($\sim$10 %). It is also volatile in acidic media and prone to contamination during analytical treatment. Nevertheless, an increasing number of isotope laboratories are successfully using boron isotope compositions (expressed in δ11B) in marine biogenic carbonates to reconstruct seawater pH. Recent interlaboratory comparison efforts [1] highlighted the existence of a relatively high level of disagreement between laboratories when measuring such material, so in order to further strengthen the validity of this carbonate system proxy, appropriate reference materials need to be urgently characterised. We describe here the latest results of the Boron Isotope Intercomparison Project (BIIP) where we aim to characterise the boron isotopic composition of two marine carbonates: Japanese Geological Survey carbonate standard materials JCp-1 (coral porites) [2] and JCt-1 (Giant Clam) [3].

This boron isotope interlaboratory comparison study has two aims: (i) to assess to what extent chemical pre-treatment, aimed at removing organic material, can influence the resulting carbonate δ11B; (ii) to determine the isotopic composition of the two reference materials with a number of analytical techniques to provide the community with reference δ11B values for JCp-1 and JCt-1 and to further explore any differences related to analytical technique. In total eight isotope laboratories participated, of which one determined δ11B via negative thermal ionisation mass spectrometry (NTIMS) and seven used multi collector inductively coupled plasma mass spectrometry (MC-ICPMS). For the latter several different introduction systems and chemical purification methods were used.

Overall the results are strikingly consistent between the participating labs. The oxidation of organic material slightly lowered the median δ11B by $\sim$0.1 ‰ for both JCp-1 and JCt-1, while the mean δ11B of all labs for both standards was lowered by 0.20 ‰ for JCp-1 and 0.15 ‰ for JCt-1, hence within uncertainty of the reported values. With the exception of one MC-ICPMS lab that provided significantly lower JCp-1 δ11B data for unoxidised material (1.7 ‰ below median), the remaining JCp-1 results reproduced within ± 0.54 ‰ for unoxidised (n=21) and ± 0.37 ‰ for oxidised standards (n=21). The JCt-1 standards did not reproduce as well, resulting in a 2 s.d. of 1.0 ‰ for both unoxidised and oxidised powders (n=21) and in places the effect of oxidation appeared to be laboratory dependent. Exclusion of one MC-ICPMS lab resulted in an improved reproducibility of 0.52 ‰ (n=18) for oxidised JCt-1 material. The mean difference for the two standard materials in the respective labs (i.e. $\Delta\delta$11B = mean δ11B(JCp-1) – mean δ11B(JCt-1)) was 7.9 ± 0.9 ‰ for unoxidised (n=7) and 8.1 ± 0.7 ‰ for oxidised standards (n=7).

In this presentation emphasis will also be placed on distinguishing factors leading to increased/decreased interlaboratory consistency during the preparation and analysis of biogenic carbonates for other isotopic systems.

References

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